

#### **8.4 Site-Wide Biota Monitoring – BAS**

The BAS was established as a result of the “Agreement for a Conceptual Remedy for the Cleanup of the Rocky Mountain Arsenal” to permit the further investigation of other identified areas of potential residual risk outside the areas set for remediation. The BAS will focus on the planning and conduct of both the USFWS biomonitoring programs and the Supplemental Field Study (SFS)/risk assessment process and will provide interpretation of results and recommendations to the Parties’ decision makers. The BAS will serve as a technical resource to the Parties’ decision makers by using technical expertise in analyzing, and potentially collecting data sufficient to support design refinement for surficial soil areas and aquatic resources in order to break unacceptable exposure pathways in consideration of minimizing habitat disturbance. Further, it will assess through monitoring, the efficacy of remedies on breaking unacceptable exposure pathways to biota.

#### **8.5 Site-Wide Air Monitoring – Air Pathways Analysis**

The Air Pathways Analysis (APA) program is designed to protect the health of all on-site construction and management personnel, RMA visitors, and nearby communities. It is also designed to minimize nuisance odors. It is comprised of six individual tasks: Air Criteria Development; Tier I Emission Measurements; Integrated Comprehensive APA Model Packaging; Predictive Emission Model Development; Air Monitoring during Remediation; and Development of Remediation and Waste Handling Scenarios. All six tasks are basically complete, although refinements to the air pathway modeling scenarios and emissions controls will continue throughout the remedy. Specific protocols and reporting mechanisms are identified in the site-wide air and odor plans, if certain air, odor or dust criteria are met. Site-wide ambient air and odor monitoring will be performed at the RMA fenceline, at on-site locations, and in the community to verify that impacts from remediation activities are below Air Criteria

#### **8.6 Contingent Soil Volume**

Contingent Soil Volumes will be identified based on visual field observations and analytical results of confirmatory samples. Fourteen samples from the North Plants, Toxic Storage Yards, Lake Sediments, Sand Creek Lateral, and Burial Trenches and up to 1,000 additional confirmatory samples may be used to identify the Contingent Soil Volume requiring excavation. A total remedy Contingent Soil Volume of up to 150,000 bcy may be identified for excavation and landfill.

Identification, sampling, and excavation of Contingent Soil Volumes will be performed as part of each project. However, for purposes of costing and incorporation of all ROD elements, Contingent Soil Volumes are identified as a separate project in the RDIS.

## 8.7 Site-Wide Plume Monitoring

Site-wide monitoring will be conducted to evaluate the effectiveness of the remedy and verify that the remedy is protective of human health and the environment with regard to groundwater and surface water. Site-wide monitoring also is intended to measure changing conditions during and after remediation and provide data for the CERCLA 5-Year Site Reviews. Site-wide monitoring is divided into three categories: Groundwater Monitoring, Surface Water Monitoring, and Surface Water Management. Each of these categories will be discussed in more detail in subsequent sections.

### *Groundwater Monitoring*

Groundwater monitoring at RMA includes many components with the purposes of evaluating the effectiveness of the remedy, measuring changing conditions during and after remediation, and providing data for the CERCLA 5-Year Site Reviews. These groundwater monitoring components include groundwater containment system monitoring, project-specific monitoring, confined flow system monitoring, Off-Post Containment System Remediation Goal (CSRG) exceedance monitoring, site-wide monitoring, and HWL monitoring. Each of these groundwater-monitoring components may include different monitoring categories. For example, groundwater containment system monitoring supports system performance validation and includes operational, conformance, and compliance monitoring categories. Monitoring reports for the groundwater containment systems are submitted to the Regulatory Agencies. Project-specific monitoring conducted at specific sites such as soil cover areas and closure/post closure areas include water level and water-quality components. Confined flow system (CFS) monitoring is conducted to determine if groundwater contamination is migrating into the CFS. The CFS underlies the unconfined flow system, which contains the majority of the groundwater contamination. Off-post CSRG exceedance monitoring is intended to track the changes in off-post plumes exceeding CRSGs and is conducted twice in each five-year period. Site-wide monitoring evaluates changes in the hydrology and the effectiveness of the site-wide remedy and is conducted annually.

Some of the more rigorous groundwater monitoring is associated with the hazardous waste landfills. Groundwater monitoring is required prior to waste placement, during operations, and during closure and post closure of hazardous waste landfills. The HWL and ELF groundwater-monitoring project includes quarterly monitoring for up to 39 monitoring wells surrounding the HWL and proposed ELF site. Results from the sampling events are submitted to the Rocky Mountain Arsenal Environment Database (RMAED) and summarized in monitoring reports that are approved by the Regulatory Agencies.

### *Surface Water Monitoring*

The implementation of the surface water-monitoring program serves two objectives: the off-post surface water monitoring is performed in accordance with the Off-Post ROD to evaluate the effect of groundwater treatment on surface water quality, while the on-post objective is the protection of aquatic ecosystems. Surface water monitoring includes the collection of water quality samples and water stage measurements on all lakes and major inflows and outflows from the RMA. Samples are collected at various sites annually or semiannually and after storm events. Upon review of all quality control and quality assurance data, the data is placed in the RMAED.

### *Surface Water Management*

Planning for the utilization of surface water at RMA is conducted each year. A surface Water Management Plan is developed which provides an assessment of water needs at RMA and establishes priorities for the use of this water. The implementation of the Surface Water Management Plan is monitored using continuous water-stage recorders on lakes and streams at the RMA that transmit water-level data every four hours. These data are used in conjunction with daily well-pumpage rates to determine where surface water supplies are to be stored and to meet requirements of water rights accounting with the State Engineers Office.

## **8.8 Confined Flow System Monitoring**

As part of site-wide plume monitoring, deep (confined aquifer) wells are monitored in the South Plants, Basin A, and Basin F areas. Initially, wells are expected to be monitored twice in five years for water quality, and annually for water levels. However, the frequency of monitoring may be increased if the data indicates that conditions are changing more rapidly as a result of implementation of the remedy. Specific wells and analytes are identified in the approved Long-Term Monitoring Plan.

## **8.9 Medical Monitoring Program**

The ROD included a provision for a medical monitoring program for communities surrounding the RMA for the duration of the soil cleanup. This was incorporated due to citizen concerns that potentially hazardous levels of airborne chemicals could be released from contaminated soil during the remediation. The Colorado Department of Public Health and Environment (CDPHE) have taken the lead role in facilitating the medical monitoring program development.

The ROD also called for the formation of a Medical Monitoring Advisory Group (MMAG), a diverse panel of community members, physicians, nurses, scientists, and state and local health officials, and representatives from EPA, Army, Shell, and the

USFWS. The MMAG is responsible for using scientific and medical data and community input to prepare sound and responsive recommendations on program components.

The MMAG submitted twelve core recommendations to the CDPHE in October 1998 as the “Rocky Mountain Arsenal Medical Monitoring Program Recommendation Final Report.” All of the recommendations were accepted and are being implemented as the RMA Medical Monitoring Program. The program will continue through the duration of the environmental cleanup.

## **8.10 Traffic Management Plan**

The purpose of the Traffic Management Plan is to coordinate traffic flow to accommodate RMA site activities. This plan addresses the conceptual layout for site traffic, the final layout, design factors, site access requirements, and haul roads. Several types of traffic will use RMA site roads during remediation. The road use philosophy of the RVO is to maximize site access to all users while maintaining safe construction practices.

Project waste haul, borrow haul, and construction traffic will be separated from public and administrative traffic. The PMC is responsible for road layout and organizing work activities and schedules to provide traffic separation. This plan provides a conceptual input to the phased approach of the site-wide remediation and addresses concerns and issues of the various entities at the site. The specifics of this plan provide guidance to the PMC for planning. PMC changes to the Traffic Management Plan must be approved by the RVO prior to implementation.

All site roads including haul roads for waste material will be maintained and considered clean. Preventive measures, such as covered haul vehicles and decontamination and excavation practices, will be used to maintain non-contaminated roads. If an accidental spill occurs, all waste will be cleared from the road and removed. Traffic management will also maintain roadbeds, stormwater drainage systems, install, and maintain traffic controls, and designate safety standards during haul road use.

As site cleanup progresses, many roads in the outlying areas will not be needed for further operations. The RVO may then direct the PMC to remove those roads. At the direction of the RVO, the PMC will remove the identified road, use the excavated material where possible, and restore the former road area to blend with the natural topography. At RVO direction, the PMC may also convert all or portions of former haul roads into tram routes for USFWS use.

## **8.11 Geophysical Surveying**

The purpose of the Geophysical Surveying is to minimize the risk of potential hazards from Munitions and Explosives of Concern (MEC) and underground anomalies during

the remediation process. Geophysical Surveying will be done in areas designated by the RVO as potential MEC sites prior to the commencement of work in those areas.

### **8.12 UXO Disposal**

An onsite UXO team has been assembled to provide emergency response to identify and manage anomalies that have the potential for being explosively energetic or containing recovered chemical warfare materials. The UXO manager is responsible for managing UXO subcontractors and UXO related geophysical activities in support of remediation efforts.

Additional support is available if needed from the Technical Escort Unit (TEU). The TEU is an Army unit based in Aberdeen, MD and specializes in the identification, handling, transportation, and emergency destruction of OE and UXO.

### **8.13 Biota Barrier**

The Stapleton concrete project identifies and provides funds for the purchase of reclaimed concrete from the former Stapleton International Airport for the use as biota barrier materials for several remediation projects at RMA. The concrete will be reclaimed, processed, and stockpiled at Stapleton until required for cap construction. The concrete, which must be reclaimed from Stapleton redevelopment acreage, is a cost-effective purchase for RVO remediation due to short travel distance and the correct match of source quantities with required end use quantities. The project has developed standards for concrete of acceptable strength, density, gradation of concrete pieces, and purity of content to serve as biota barrier material. The project will also designate stockpile areas and methods of supplier delivery. The project is not a remediation activity in itself, but takes advantage of economies of scale, answers a current civic need, and provides a large quantity of material essential to remediation activities.

### **8.14 Permanent Revegetation/Irrigation/Mitigation Program**

The ROD-required remedy components include reconditioning the surface soil and revegetation of areas disturbed during remediation with locally adapted perennial vegetation. The objective of this program is to design, schedule and implement a plan for efficient permanent revegetation of disturbed sites, as well as other areas of low quality habitat at RMA. Work will be conducted jointly by USFWS and the PMC. The plan will be based upon the 1997 Habitat Restoration Plan and updates to the associated Terrestrial Revegetation Map. Soil amendments, site-wide water requirements, seeding, irrigation, erosion potential, prairie dog colony expansion and small mammal recolonization will be considered. The plan will determine a year-by-year schedule and be updated annually based upon current revegetation requirements.

### **8.15 Drummed Waste Handling (Plan Development Only)**

This project includes an evaluation of a centralized versus decentralized drummed waste disposal handling facility. If a centralized facility is recommended, the location of the centralized facility will be identified. Also included will be a determination of how drummed waste will be managed, including, but not limited to; inventory and waste profile analysis, transportation requirements, storage requirements, liquids management, compatibility, evaluation of shredding empty versus full drums, verification that material will pass paint filter, work plans which include health and safety requirements, quality assurance and air monitoring plans, and coordination with HWL operations.

### **8.16 Site-Wide Well Abandonment**

The Well Abandonment project is tasked with abandonment of wells within the Central Remediation Area (CRA) that will not be used in long-term groundwater monitoring. In the past, wells were abandoned each year based on the implementation projects scheduled for that year. To save costs for mobilization and oversight, a consolidated campaign to abandon all wells that will not be used in the CRA will be implemented. The second half of this site wide program was the development of a well network retention and closure program. On an annual basis, a listing of all remaining wells will be reviewed and all wells not needed for monitoring purposes will be included in a list of wells available for closure. Wells will be closed from this list based on available funding.

## **9.0 WATER TREATMENT/MONITORING**

The water treatment and monitoring activities consist of operation and maintenance of existing treatment plants, deep well abandonment, and South Adams County water supply. This section will provide a brief narrative of the programs.

### **9.1 South Adams County Water Supply/Henderson Distribution**

The Army and Shell are to provide \$48.8 million to South Adams County Water and Sanitation District (SACWSD). The money is to be used for two projects. The first project is to acquire and deliver 4000 acre-feet of potable water as an additional water source for the residents served by SACWSD. To accomplish this, SACWSD, with the concurrence of the Army and Shell, hired an independent qualified agent (water resource expert) to research potential sources of water and negotiate the acquisition of 4000 acre-feet of Denver Water. Currently, SACWSD and Denver Water are obtaining storage reservoirs and conveyance systems as part of the water agreement signed in November 1998 by SACWSD, Denver Water Board, U.S. Army, and the USFWS. If a complete water delivery system is not in place and operational by September 2004, the unused portion of the money and responsibility for acquiring a supplemental water supply reverts to the Army and Shell. The Army has completed all National Environmental Policy Act

(NEPA) requirements. The second project is to complete and provide potable water to the residents within the DIMP plume footprint north of RMA, primarily in Henderson.

## **9.2 On-Post Water Supply**

The Army and the USFWS will seek to enter into an agreement with the Denver Water Board to acquire an interim and long-term nonpotable water supply. The interim water, will service the RMA's remediation and revegetation needs. The permanent water deliveries will maintain lakes and wetlands on the National Wildlife Refuge in perpetuity.

## **9.3 Section 36 Bedrock Ridge Groundwater Plume Extraction System (Monitoring)**

This item is the long-term operations and maintenance (O&M) of the Bedrock Ridge Groundwater Plume Extraction System. Long-term O&M will be performed under the Basin A Neck system (See Sections 4.8 and 9.6).

## **9.4 Confined Flow System Well Closures**

Monitoring wells that penetrate the deep (confined) aquifer were evaluated to determine if they represent pathways for water from the overlying (unconfined) aquifer to migrate downward to the deep aquifer. Fifty-one wells are to be closed and sealed. No replacement wells are to be installed during this task.

## **9.5 Irondale Containment System**

The Irondale System, located in Sections 33 and 28, consists of extraction and recharge wells and carbon adsorption for removal of organic contaminants. In addition, extraction systems located in Sections 3 and 4 remove contaminants from the rail classification yard and motor pool plumes. Contaminants for which CSRGs have been established in the ROD include TCE and DBCP. The Army and Shell will continue to operate the system for two years from the signing of the ROD, or until the railyard and motorpool plumes no longer require treatment at the Irondale system.

## **9.6 Basin A Neck System**

The Basin A Neck System (BANS), located in Sections 35 and 26, consists of extraction wells and recharge trenches, a slurry wall, and carbon adsorption for removal of organics. Contaminants for which CSRGs have been established in the ROD include volatile halogenated organics, volatile hydrocarbon compounds, volatile aromatic organics, organosulfur compounds related to mustard agent and herbicides, organophosphorus

compounds related to pesticides, organochlorine pesticides, arsenic, and mercury. The Army and Shell will continue to operate the system until the shutdown criteria identified in the ROD, Chapter 9 have been met.

In addition, water from the well north of former Basin F is piped to the system for treatment and reinjection. The water north of Basin F is air-stripped for volatiles prior to mixing with the BANS influent. Starting in FY00, groundwater from the Section 36 Bedrock Ridge Groundwater Plume Extraction System will be piped to the system for treatment and reinjection.

#### *North of Basin F Groundwater Plume Remediation*

The north of Basin F groundwater contamination plume is located to the north of the central area of the Arsenal. The contamination plume contains many organic chemicals, including TCE, tetrachloroethylene (PCE), chloroform, methylene chloride, vinyl chloride, dieldrin, dicyclopentadiene, and DIMP. Up until August 2000 this groundwater plume was pumped from the ground and treated at Basin A Neck. This type of treatment is very costly and creates secondary hazardous waste that must be disposed.

Under an EPA lead program, the EPA will test an in situ groundwater treatment using Hydrogen Release Compound (HRC). HRC is an environmentally safe, food quality product that increases bacterial breakdown of groundwater contamination. The program will first conduct laboratory tests to show that HRC works to destroy the groundwater contamination present at the Arsenal. Based on favorable lab results, the next step will be to construct a field test at the Arsenal. The test will consist of injecting HRC at 41 points to a depth of 50 to 54 feet and installing monitoring wells both up and down gradient of the test area. Reduction in the contamination levels will be determined by the testing of samples from the monitoring wells, and sample results will be evaluated to determine the effectiveness of the technology.

### **9.7 CERCLA Wastewater Treatment Facility**

The CERCLA Wastewater Treatment Facility was built primarily for treatment of investigation or remediation derived liquid waste. The CERCLA Wastewater Treatment Facility treats wastewater using any or all of a multistage process including chemical precipitation, dual media filtration, activated alumina adsorption, air stripping, carbon adsorption, and ultraviolet oxidation. Treated water is piped to the BANS for reinjection.

#### *Mass Removal System*

Modifications to the existing treatment plant will be performed to allow for the treatment of groundwater extracted from the South Tank Farm Plume and Lime Basins Groundwater Mass Removal Systems. These modifications will include: the addition of storage and pumping systems to allow for the return of the tested groundwater to its



respective recharge systems; and minor modification to the piping and control systems to accommodate the revised process configurations planned for the existing systems.

## **9.8 Northwest Boundary Containment System**

The Northwest Boundary Containment System (NBCS), located in Sections 22 and 27, consists of extraction and recharge wells and trenches, a slurry wall, and carbon adsorption for removal of organics. Contaminants for which CSRGs have been established in the ROD include volatile halogenated organics, DIMP, n-nitrosodimethylamine (NDMA), organochlorine pesticides, and arsenic. The Army and Shell will continue to operate the system until the shutdown criteria as identified in Chapter 9 of the ROD have been met.

## **9.9 North Boundary Containment System**

The NBCS, located in Sections 23 and 24, consists of extraction and recharge wells and trenches, a slurry wall, and carbon adsorption for removal of organics. Based on the results of the NDMA Alternatives Evaluation study, a future modification will also treat NDMA by ultraviolet oxidation following the carbon adsorption treatment. Although CSRGs have been defined for chloride and sulfate, the system is not designed to treat for them. They are expected to attenuate naturally as described in the Site Wide Plume project. In addition, part of the high sulfate is naturally occurring; the CSRG may be the background concentration. Contaminants for which CSRGs have been established in the ROD include volatile halogenated organics, volatile hydrocarbon compounds, volatile aromatic organics, organosulfur compounds related to mustard agent and herbicides, DIMP, organophosphorus compounds related to pesticides, organochlorine pesticides, DBCP, NDMA, arsenic, and the anions fluoride, chloride, and sulfate. The Army and Shell will continue to operate the system until the shutdown criteria identified in the ROD, Chapter 9 have been met.

An agreement by the RMA Committee to modify the NBCS was signed May 28, 1997. The modification includes acquiring and installing a ultraviolet (UV) oxidation treatment system to remediate NDMA contaminants.

Following a U.S. EPA Superfund Innovative Technology Evaluation (SITE) program demonstration to test the effectiveness of a HRC bioremediation process; a HRC enhancement program has been added to the North Boundary Containment System.

## **9.10 South Lakes Plume Monitoring**

The ROD states: “Lake level maintenance or other means of hydraulic containment or plume control will be used to prevent South Plants plumes from migrating into the lakes at concentrations exceeding CSRGs in groundwater at the point of discharge.

Groundwater monitoring will be used to demonstrate compliance.” Monitoring wells have been constructed to monitor contamination and lake levels.

## **9.11 Groundwater Mass Removal**

**Site Description:** Per an agreement entitled, Resolution Agreement Groundwater Extraction/Contaminant Mass Removal Systems at the RMA; this remedy entails the extraction of groundwater from the South Tank Farm Plume and the Lime Basins area with treatment of the extracted groundwater to reduce the contaminant mass within the respective plumes.

As part of this agreement, extracted groundwater is to be processed at the CERCLA Wastewater Treatment Plant (CWTP) for recharge to the vicinity of the respective extraction well fields.

**South Tank Farm Plume.** The South Tank Farm Plume is located in the southern half of Sections 1 and 2 on the RMA. Benzene is the primary component of a composite plume. Benzene has the highest concentrations and comprises the majority of the dissolved contaminant mass in groundwater in the South Tank Farm Plume. Other contaminants include 1, 2-dichloropropane, 1, 3-dimethylbenzene, chlorobenzene, ethylbenzene, toluene, xylene, bicyclohepta (BCHPD), and dicyclopentadiene (DCPD).

**Lime Basins Groundwater.** The extraction system will be located in the southwestern corner of Section 36. Chloroform is the primary component of the composite groundwater plume with numerous constituents. Chloroform has the highest concentrations and comprises the majority of the dissolved contaminant mass in groundwater. Other contaminants with high concentrations include 1, 2-dichlorobenzene, 1,4-dichlorobenzene, arsenic, benzene, chlorobenzene, acetone and methylene chloride.

### **Project Description:**

- a) Install mass removal system in the South Tank Farm Plume to include extraction wells, recharge wells, pumps electrical supply, and piping.
- b) Install mass removal system in the Lime Basins area to include extraction wells recharge trench, pumps, electrical supply, and piping.
- c) Install upgrades to the CERCLA Water Treatment Plant.

## **10.0 REMEDIATION VENTURE OFFICE**

The RVO (Army, Shell, and USFWS) is responsible for the overall management and execution of the remedy to include: Program Management; Remedy Support and Operations; Remedy Execution; Mitigation/Restoration; Program Controls; and Public

Outreach. For scheduling purposes, this section includes mission support shared costs, such as EPA and State costs, facilities maintenance, estimated PMC costs, and other costs incurred during the execution of the ROD remedy.

## **11.0 PROGRAM MANAGEMENT**

This section includes party-specific costs for five major sections: Program Management, Remedy Support, Remedy Execution, Mitigation/Restoration, and Program Controls. This section also includes discussion of the completion of the remedial action and the trust fund.

### **11.1 Completion of Remedial Action**

A milestone date defined as when all remediation/construction (fieldwork) excluding longterm operations and maintenance activities, are complete.

### **11.2 Trust Fund**

The ROD states, “During the formulation and selection of the remedy, members of the public and some local government organizations expressed keen interest in the creation of a Trust Fund to help ensure the long-term operation and maintenance of the remedy once the remedial structures and systems are installed. In response to this interest, the Parties have committed to good-faith best efforts to establish a Trust Fund for the operation and maintenance of the remedy, including habitat and surficial soil.” The target date to have the trust fund established is 2008.

## **12.0 OFF-POST REMEDY**

The Off-Post remedy section discusses three projects identified in the Off-Post Implementation Plan: off-post surficial soil, off-post water treatment, and off-post well closure. These three items are provided on the On-Post RDIS schedule to account for the funds necessary to accomplish these projects. A more detailed discussion of the projects may be found in the Off-Post ROD.

### **12.1 Off-Post Surficial Soil**

Approximately 160 acres located in the southeast portion of Section 14 and the southwest portion of Section 13 are to be revegetated. The surficial soil is to be tilled and thoroughly mixed to a depth of about 12 inches below the surface; then, the area is to be seeded with a mix of plant species to protect soil from erosion and establish a self-sustaining plant community.

## **12.2 Off-Post Water Treatment Facility**

The Off-Post Groundwater Intercept and Treatment System was designed to extract and treat contaminated alluvial groundwater from the First Creek and Northern Pathways downgradient of the NBCS, and return treated water to the alluvial aquifer. The system consists of a network of upgradient extraction wells, located in two separate well fields, an activated carbon adsorption treatment system for removal of organics, and a network of recharge wells or trenches. Contaminants for which CSRGs have been established in the Implementation Plan for the Off-Post Operable Unit (OU) include volatile halogenated organics, volatile hydrocarbon compounds, volatile aromatic organics, organosulfur compounds, DIMP, organophosphorus pesticides, organochlorine pesticides, DBCP, NDMA, arsenic, and the anions fluoride, chloride, and sulfate. The Army and Shell will continue to operate the system until the shutdown criteria identified in the Implementation Plan for the Off-Post OU have been met.

## **12.3 Off-Post Well Closure**

Five wells located within the off-post study area are to be closed because the wells were poorly constructed and potentially acting as a downward contaminant migration pathway into the Arapahoe Aquifer. Monitoring wells that are no longer in use will also be closed. Specific criteria to determine if wells will be closed are identified in Section 7.4 of the Implementation Plan for the Off-Post OU. A list of wells meeting the closure criteria was agreed to by the technical staffs representing the RVO, EPA, CDPHE, and Tri-County Health Department.



